ARGONNE UNDERGRADUATE RESEARCH SYMPOSIUM – OCTOBER 24-25, 2003
Materials Sciences

USE OF THE MAGNETIC FORCE MICROSCOPE (MFM) FOR DOMAIN WALL IMAGING IN MAGNETOELASTIC TORQUE SENSORS

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In this study, we created two distinct portions of the torque sensor ring or shaft in which a high degree of oppositely polarized circumferential magnetization was maintained with a saturated alignment of the magnetic domains due to the high circumferential coercive force. This sensory area produces a field signal linearly proportional to the applied torque. The ring sample was constructed of a steel alloy of 18% nickel in iron (known as C250), while the shafts used were steel alloys of 0.5% chromium and 0.3% nickel, 0.5% chromium and 4% nickel, 3.5% chromium and 0% nickel, and 12% chromium and 0.3% nickel (known as O-1, Kapstar, S-7, and D-2 respectively). Previously unknown has been the exact nature of the interface between the regions of opposing circumferential magnetization. In this study, we have used the magnetic force probe of our AFM, in an imaging technique known as MFM, to determine the width and sharpness of the domain wall transition region between the two oppositely polarized regions of both types of sensors and their relative depth of magnetic alignment. We found the domain wall transition region to be much wider and to change in a more gradual manner in the shaft sensors. However, following the heat treatment of the shaft-type sensors, the width of their domain walls began to approach that of the ring-type sensor. We also found that the relative height of the domain wall signals compared to the background signals was in direct correlation with the torque load sensitivity numbers measured for each of the samples.